Developing Online Reading Comprehension: Changes, Challenges and Consequences

Introduction

The emergence of the Internet as a powerful communication, literacy and learning tool has led to calls in the literature for a reconceptualisation of what literacy entails in the 21st century (Flood & Lapp, 1995; International Reading Association (IRA), 2009; Reinking, 1998). One's ability to access, critically evaluate, synthesise and communicate information quickly, efficiently and effectively are key components to active and full participation in a global world (Leu & Kinzer, 2000). While online reading skills are built on foundational print-based skills, online reading comprehension is not isomorphic with print-based literacies and additional skills and strategies may be required to fully exploit the potential of the Internet as a site for learning (Leu, Kinzer, Coiro & Cammack, 2004).

This chapter explores how the changing nature of literacy in an online environment impact on the development of students' online reading comprehension and information-seeking skills and strategies. It seeks to address the challenges presented for students when conducting information searches online. Further, it explores the challenges for classroom teachers in adopting new pedagogies to accommodate a new literacies curriculum. Finally, it considers the consequences that these changes and challenges have on pedagogy, the development of a classroom curriculum and the creation of learning communities within classrooms.

Changes Brought About to Literacy with the Advent of the Internet and other ICTs

The Internet is an n-dimensional (Harrison, 2008), non-linear (Bolter, 1998), multimodal (Kress, 2003, 2010), post-textualist (Purves, 1998) environment. Afflerbach and Cho (2009a) note that Internet reading embodies a "fundamental change in the architecture of acts of reading" (p.81). Emerging research suggests that online reading skills are built on related processing and cognitive print-based skills, such as automaticity in decoding, word recognition and reading fluency. However, online reading introduces additional complexities to the *acts of reading* and higher levels of strategic processing, cognitive skills and strategies and affective dimensions may be required to fully exploit the Internet's potential as a tool for literacy and learning (Afflerbach & Cho, 2009a; Coiro, 2007; Hartman, Morsink, & Zheng, 2010; IRA, 2009; RAND Reading Study Group, 2002; Zhang & Duke, 2008). The literature seems to suggest that *reading strategies* and *reading skills* are at opposite ends of a continuum. Whereas strategies suggest effortful, goal-directed and conscious actions on the part of the reader to construct meaning from text, skills are characterised by automaticity, fluency, and effortlessness, often without the explicit conscious control of the reader (Afflerbach, Pearson & Paris, 2008; Dole, Nokes & Drits, 2009; Pressley & Harris, 2006). Reading strategies have been described as "skills under consideration" (Paris, Lipson & Wixson, 1983, p. 295). Furthermore, it appears that the good reader has the ability to "shift seamlessly" (Afflerbach et al., 2008, p. 371) between the automatic use of a reading skill to the effortful use of a reading strategy.

The sections which follow explore some of the additional complexities introduced for readers in an online environment and how the interactions between the reader, the text and the activity within a sociocultural environment changes in such an online environment.

Firstly, the online reader is more effortful in "realising and constructing potential texts to read" (Afflerbach & Cho, 2009b, p. 209). It is the reader, rather than the author, who determines a unique pathway through the fluidity of online text. The reader must read selectively and strategically, monitoring the text to be read, while at the same time avoiding unwarranted distractions, such as advertisements. The interaction between the reader, text and the activity may be more dynamic, opportunistic and interactive in an online environment (Mc Eneaney, 2006). Although the reader of a print text may choose to read nonfiction or indeed fiction in a non-linear manner, the text is a stable, fixed entity confined within the bounds of the book cover. The reader is aware of exactly where they are in the print-based text and indeed the physical length of such a text.

Secondly, the content of hyperlinks is hidden from view and consequently the online reader is less able to construct meaning by drawing on contextual information. Therefore, predictive inferencing becomes necessary to unpack this hidden content (Coiro & Dobler, 2007). Hyperlinks are "constant decision points" (Kuiper & Volman, 2008, p. 249). Overviewing of text, i.e. skimming and scanning, is qualitatively different in an online environment where the online reader must engage in predictions of partially obscured content by navigating within hyperlinks and across web pages engaging in what amounts to "slightly educated guesses" (Afflerbach & Cho, 2009b, p. 204) to anticipate the relevancy of the information to the task focus.

Thirdly, self-regulation and persistence in an online environment is crucial to avoid the cognitive overload and disorientation often experienced by online readers (Nachmias & Gilad, 2002). The online reader must be involved in active decision making processes (Duke, Schmar-Dobler, & Zhang, 2006), such as planning, monitoring, predicting and questioning (Coiro & Dobler, 2007) as he/she moves speedily and efficiently (Leu at al., 2004) across

web sites ‘berrypicking’ (Bates, 1989) information and making intertextual (Hartman, 1995) links across and within texts on-the-hoof to assemble ideas, recall, summarise and synthesise the information retrieved. Learner control and choice is heightened in an online environment. When searching for information online the reader generates search strings and evaluates search results, chooses which hyperlink is pertinent to the task and which is extraneous, judges what information to skim quickly and what information to scan carefully. While this can both empower and liberate the online reader it can also be daunting for those readers with limited online skills. The online environment can be a challenging landscape where Mc Comb’s (1996) notion of self-as-agent is crucially important to develop as readers orient themselves (Hill & Hannafin, 1997), exercise high levels of self-efficacy (Tsai & Tsai, 2003), persistence (Bilal, 2000), resilience (Coiro, in process) and flexibility to takes responsibility for their own learning in a dynamic shifting environment (Dalton & Proctor, 2008).

Fourthly, the online reader must draw flexibly on a wide range of prior knowledge sources in an online environment. These include the activation of prior knowledge of the *architecture of online informational text structures* (e.g. menu, hyperlinks and multimodal supports); an ability to draw on *Internet application knowledge* (e.g. navigational Internet browser features); a facility to engage with domain and topic knowledge while concomitantly connecting with *world knowledge*. What is unclear, at present, is the role of each of these prior knowledge sources as they fuse in an online environment. For example, what level of automaticity of prior knowledge in online informational text structures and Internet application knowledge is required to free up the cognitive energy of the online reader to focus on and connect with prior domain, topic and world knowledge? (Hill & Hannafin, 1997; Lawless & Kulikowich, 1998; Moos & Azevedo, 2008). What level of domain and topic knowledge is needed to allow online readers to access a sufficiently extensive vocabulary

range to generate and revise search strings, investigate search results with a critical eye, and judge the accuracy, authority, relevance and importance of information in text to the task at hand? (Allington & Mc Gill-Franzen, 2009; Dwyer, 2010). Finally, what is the role of knowledge gathered on-the-hoof by the navigational decisions of online readers across multiple websites where online readers accrue new knowledge and update their prior knowledge sources in the malleable moments of Internet searching? (Coiro, 2007; DeSchryver & Spiro, 2008; Leu, O'Byrne, Zawlinski, McVerry, Everett-Cocapardo, 2009).

In sum, the Internet and other ICTs introduce additional complexities to the *acts of reading* for the online reader. Drawing on and extending Pearson's (2009) use of metaphor, the online reader is a "*builder*" (drawing concurrently on a wider range of prior knowledge sources while developing 'schemas-of-the-moment' (DeSchryver & Spiro, 2008, p. 9); a "*fixer*" (utilising metacognitive, self-regulatory, active decision making processes in a recursive and integrative fashion); an *assembler* (using top-down and bottom-up skills and strategies on-the-hoof; including recall, summarisation and synthesis across a labyrinth of linked texts); and a *responder* (both in efferent and aesthetic modes (Rosenblatt, 1978) and as a critic and a critical evaluator and consumer of text in an ill-structured and un-scrutinised domain (Spiro, Coulson, Feltovich, & Anderson, 2004). These changes present challenges for students in an online environment. In turn, they present challenges for teachers to enable them to construct effective pedagogies and curriculum to accommodate the new literacies into learning in the 21st century classroom (Reinking, Labbo, & Mc Kenna, 2000).

Challenges for Students and Their Teachers in an Online Environment

There is a dissonance between the in-school and out-of-school literacies experienced by our students (Alvermann, 2008). Our students' literacy and technology lives outside of school incorporate social networking, emailing, and texting, uploading and downloading

videos, and engaging with gaming applications. However, research has shown that the high level of prowess with technology use afforded to the 'Digital Native' (Prensky, 2001) generation lacks credibility in the research-based literature (Bennett, Matton & Kervin, 2008; University College London CIBER Group, 2008). Research suggests that students face difficulties in a number of areas related to both reading comprehension and completing information searches in an online environment. For example, students are unlikely to be critical consumers of online information and have difficulty in evaluating online information for quality, credibility, authority and reliability (Hirsh, 1999; Leu et al., 2008)

The new literacies perspective (Leu et al., 2004; Coiro, Knoebel, Lankshear, & Leu, 2008) posit that searching for information online is a "problem-based inquiry process" (Leu et al., 2008, p. 323) requiring skills, strategies and affective dimensions in posing effective questions to structure online inquiry; locating relevant information; critically assessing the currency of that information to the task question; and synthesising and communicating that information to others. The sections which follow discuss the challenges for students when searching for information in an online environment.

Planning and Setting Goals for Online Information Searches

For purposeful reading and inquiry on the Internet it is important that students formulate engaging questions to provide a purpose for their inquiry, set a context for problem solving and establish a goal for learning (Owens, Hester, & Teale, 2002). Zhang and Duke (2008) also note the difference between reader characteristics depending on the nature of the task. For example, online readers may process text differently if browsing for recreational purposes, searching for specific information or reading to develop conceptual knowledge.

Studies suggest that students rarely plan or articulate the goal of information-seeking or engage in strategy formulation when conducting Internet inquiry (Burke, 2000; Fidel et al.,

1999). This adds to the feelings of frustration encountered by online readers where the expectation that the answer to a poorly articulated question is but a mere 'click' away (Kuiper & Volman, 2008). The feeling of disorientation experienced by online readers has been well documented in the literature, where readers become overwhelmed both by the amount of information retrieved (Foltz, 1996; Treymayne & Dunwoody, 2001) and the feeling of being lost in hyperspace (Edwards & Hardman, 1999).

Generating Search Terms and Investigating Search Results

The online information inquiry process encompasses both the ability to generate and revise search strings and investigate search results in a critical manner. Both of these gatekeeper skills (Henry, 2006) are necessary for the retrieval of online information. Research indicates that students at elementary (Kafai & Bates, 1997; Fidel et al., 1999; Wallace & Kupperman, 1997) and high school levels (Nahl & Harada, 1996) have difficulties formulating search strings. Factors compounding these difficulties include insufficient prior knowledge of search engine algorithms; inadequate domain and topic knowledge to generate effective keywords; insufficient vocabulary knowledge for synonym and superordination generation; and flexibility at a conditional level of knowledge (Lipson & Wixson, 1986) to generate, monitor and revise search string keywords (Bilal, 2001; Kuiper & Volman, 2008; Schacter, Chung, & Dorr, 1998).

The ability to investigate search results speedily and with a critical eye is an important Internet skill. Research findings indicate that students rarely venture beyond the first few results; have difficulty with the level of abstraction necessary to successfully construct meaning from the search result paragraph (Bilal, 2000); and seldom use the search result heading to assess the relevance of the search result to the task (Fidel et al., 1999; Hill & Hannafin, 1997; Kafai & Bates, 1997). Emerging research suggests a taxonomy of skills in

investigating search results. Firstly, a random (Guinee, Eagleton, & Hall, 2003) "*click and look*" (Leu et al., 2007) strategy with minimal reading of search results. Secondly, a *limited strategic scrolling* of search results (Dwyer, 2010) where each result, in turn, is systemically investigated. Finally, a *skilful investigation strategy* (Dwyer, 2010) where the relevance of each result is assessed by critiquing evidence provided by the URL and the abstract paragraph, matching this to the task goal and doing so speedily, efficiently and automatically.

Generating and revising search strings and investing search results with a critical eye are crucial skills in the process of locating online information. Both facilitate the online reader to locate information relevant to their task goal. The section which follows considers the challenges for students in locating online information.

Locating Online Information

Locating information in an online environment has been referred to as "a nontrivial complex skill" (Nachmias & Gilad, 2002, p. 481). Some of the main challenges experienced by online readers include a capacity to manage an information overload; an inability to evaluate the relevancy of information to the task focus; equating the quantity of information with the quality of that information (i.e. quantity equals quality); and a facility to separate the wheat from the chaff. The ability to self-regulate in an online environment draws on many of the skills associated with print-based skills, such as monitoring, planning, questioning and evaluating. In an online environment self-regulation acquires a higher level of complexity as the reader filters information across a myriad of texts (Bulger, 2006) and synthesises that information, thereby "spinning straw into gold" (Eagleton & Guinee, 2002, p. 52). Students also face the challenge of assessing the quality of the information retrieved for their task goal. Kuiper and Volman (2008, p.63) have questioned what they call the "consumerist nature of students" where students find an acceptable answer to a question in the shortest time possible.

They are, therefore, engaging in what Agosto (2002) has called "satisfying" behaviour finding sufficient (just enough) information to satisfy (just about do) the task set.

Studies have shown that students spend more time on the process of information seeking rather than the product of that search, i.e. reading relevant information for the task focus. In the Wallace and Kupperman study (1997), students spent 24 % of their time actually reading information on web sites. The rest of the time was spent on finding a path to that information. Authors (Birkerts, 1994; Purves, 1998) have noted the cursory, superficiality of the information retrieved and the lack of depth in growth of conceptual learning and knowledge development during online activity. It is therefore important that we support our students to grasp the opportunities presented for learning with the Internet and to deepen their learning experiences online.

Evaluation of Online Information

Evaluation of online information includes critical evaluation skills (e.g. assessing reliability and accuracy of information; critical thinking skills (e.g. a disposition for interrogating the text); critical literacy skills (e.g. assessing author purpose, stance and bias); and media-savviness and information literacy skills (e.g. establishing trustworthiness and reasonableness of information presented). Critical evaluation of information introduces new complexities for the online reader as the Internet is an un-vetted open network where anyone can publish any information. Evaluation of information draws on exercising one's ability to comprehend, apply, analyse and synthesise information. Previous studies reveal that students face challenges in realising that misleading and erroneous information can be placed on the web (Schacter et al., 1998); are unaware of the need to challenge the veracity, authority and reliability of information presented (Shenton & Dixon 2004; Wallace & Kupperman, 1997); are misled by the appearance of a website (Sutherland–Smith, 2002); and struggle to detect

hidden author agendas (Fabos, 2008). In addition, students need to draw on a maturity of reflection and a world experience and knowledge that they simply do not have. Therefore, it is important to help our students to read with their antennae raised so that they develop a "healthy scepticism" (Leu et al., 2007) about what they read in an online environment.

Communication of Information

Web 2.0 and beyond introduced new possibilities for all online readers to be online authors and producers of texts (Malloy, Castek, & Leu, 2010). Online platforms are continually emerging and include shared reading, writing and communication spaces, such as Nings, Wikis and Google Docs; threaded discussion boards; and online social networking sites, such as Facebook, Edmodo, and Twitter. The Internet expands our vision of 'audience' and 'community of learners' beyond the four walls of the classroom to encompass a global classroom network. Here, students can engage in collaborative communities, such as ePals, to jointly co-construct meaning by engaging in socio-collaborative reading of texts (Hartman, Morsink, & Zheng, 2010) to communicate, transact and respond with others in an online environment.

Challenges for Teachers in an Online Environment

While some teachers are successfully integrating the Internet and other ICTs into the curriculum (Crook, Harrison, Farrington-Flint, Tomás, Underwoood, 2010) many are not (Hutchinson & Reinking, 2011). The reasons which are cited by teachers include: a lack of infrastructural and technical support; an insufficient knowledge base; a fear of change; an already overloaded curriculum; and limited opportunities for professional development. Developing content and pedagogical knowledge (Shulman, 1987) is no longer sufficient to meet the needs of the 21st century classroom. The Technological Pedagogical Content

Knowledge (TPCK) framework proposed by Mishra and Koehler (2006) promotes the flexible orchestration, transaction and integration of pedagogy, content and technology. The TPCK framework allows teachers to draw flexibly from, and integrate knowledge of, pedagogy, content and technology to develop appropriate classroom frameworks, curriculum and instructional practices to support learning with the new literacies.

Little research has focussed on the development of curriculum or instructional contexts in classroom environments which support the development of effective online reading skills (Castek, 2008; Dalton, Proctor, Uccelli, Mo, & Snow, 2011; Eagleton & Dobler, 2007; Leu et al., 2008). The Dwyer (2010) study sought to accommodate the new literacies of the Internet and other ICTs within an inquiry-based integrated curriculum. A brief outline of the study and its findings are presented in the section which follows and serve as an illustrative, contextual example of the possibilities of accommodating a new literacies framework within the classroom curriculum. Following this, some of the consequences for classroom curriculum, pedagogies, and conceptual learning with the Internet and other ICTs will be presented drawing both on the Dwyer (2010) study and other emerging studies in the field.

Scaffolding Internet Reading with Struggling Readers From Disadvantaged Communities

The Dwyer (2010) longitudinal study was conducted, with 3rd to 6th grade students, in a high poverty school district in Ireland. The pedagogical goal of the study was to scaffold the development of online literacies with struggling readers from disadvantaged communities within the context of the learning ecology of the classroom. The classroom learning ecology includes the complex, multilevel, dynamic, transactional interplay and interdependency, which is evolving rather than static, between multiple actors (teachers, students, school administrators, parents, the wider community, and policy makers) and multiple variables

(curriculum, pedagogies, infrastructure, resources, and technical ICT support) (Zhao & Frank, 2003) .

The study was underpinned by a formative and design experimental methodological framework (F&DE) (see Reinking & Bradley, 2008 for a full description). The F&DE framework is sympathetic to the "multiple realities" and provisionality of the classroom environment (Labbo & Reinking, 1999). The F&DE methodology is interventionist by nature; adaptive and iterative by design; and driven by a theoretically determined, valued and clearly articulated pedagogical goal in authentic learning environments. The F&DE methodological framework "serves the central goal of putting theory to work in a way that simultaneously informs and refines or generates useful theory grounded in practice" (Reinking & Bradley, 2008, p.43); thereby making firm research to practice connections while concomitantly generating theory.

The study was conducted in three inter-linked phases: the Baseline phase; Reading Development and Critical Web Literacy Development phase; and the Main Study phase. Each phase built on emerging insights from analysis of preceding phases in a spiral fashion. A range of essentially qualitative data sources were analysed using inductive and deductive methods (Miles & Huberman, 1994), on both on a micro (weekly basis) and macro basis (at the end of each phase) (Gravemeijer & Cobb, 2006). Data sources included; online recorded Internet activity; think aloud protocols (Pressley & Afflerbach, 1995); semi-structured interviews; digitally recorded group discussions, fieldnotes, lesson samples, and artefacts of students' work.

The design of the study included the development of a series of integrated cross-curricular themed units designed to develop both offline and online literacies. For example, one cross-curricular thematic unit, integrating literacy, science and the Internet, related to

Animals and their Adaptations to their Environments. Situational interest in this thematic unit was developed by conducting observations, science experiments and fieldtrips, (drawing on and adapting the Concept Oriented Reading Instruction (CORI) model (for a review of the model see Guthrie, 2004)). Graded nonfiction texts were added to the class library related to each thematic unit. The teachers adopted a novel also related to the theme as the class reader. For example, *The Butterfly Lion* (Morpurgo, 1996) related to animal adaptations.

The students also worked in mixed-ability triad groups during a series of 25 Internet workshops, conducted across the timeline of the study, in the computer lab in the school. Explicit strategy instruction, using the gradual release of responsibility model (Pearson & Gallagher, 1983), in the form of mini-lessons, modelling, and scaffolding, was utilised to develop online reading comprehension and information-seeking skills and strategies. The students conducted research, primarily on the Internet, on inquiry-based self-chosen topics related to the themed cross-curricular units. They produced online ebooks using RealeWriter software, (http://www.realewriter.com) to communicate information related to the themed units.

Students adopted leadership roles online in the guise of a Questioner, Navigator or Summariser (emulating the Palinscar & Brown, (1984) Reciprocal Teaching model. This provided a structure where students could scaffold each other's online learning activities. Peer-to-peer collaboration was also encouraged through the use of electronic share boards, class discussions, and quick shares where students reflected on their developing online skills and strategies. Across the timeline of the study learner-centered assessment (Tierney, 2000) was utilised to inform future teaching. Students were also presented with Internet inquiry challenges, which they conducted independently, at key stages of the study. For example, one inquiry challenge related to finding information on how a burmese python can swallow an

animal whole without choking. Data from these online inquiry challenges provided a digital portfolio of work, and both summative and formative evidence on the progression of online skills strategies and dispositions. Self-and peer-assessment practices and reflections also allowed the students to become stakeholders with their teachers in the assessment practices in the class (Afflerbach, 2007).

Findings from the study suggested that (a) the development of an ecological learning community within the classroom coupled with an integrated inquiry-based curriculum enhanced engagement and motivation and enabled the students to develop high levels of online reading, writing and communication skills (b) new literacies were acquired through explicit instruction, adaptive scaffolding and peer-to-peer collaboration; and (c) peer-to-peer collaboration supported the development of the cognitive, affective and social dimensions of learning in such environments.

The sections which follow review the findings from the Dwyer (2010) study, against a backdrop of other emerging studies in the field and discuss the consequences for classroom curriculum, development of classroom pedagogies and the development of learning with the Internet and other ICTs.

Discussion of the Consequences for the Development of Classroom Curriculum, Pedagogies and Learning with the Internet and other ICTs

"The content of new technologies can replicate the past or transform the future. Ultimately it will take a conscientious effort to change ways of thinking, ways of doing, ways of believing" (Young, 2008, p.352). The instructional environment with the classroom learning ecology evolved considerably across the timeline of the Dwyer (2010) study. The role of the class teacher changed from that of a transmitter of knowledge to that of a co-learner, co-constructor and ultimately a facilitator of learning. The students' role also

changed from passive recipients of knowledge to more active metacognitive constructors of knowledge as they co-constructed their own learning through collaboration with their peers and with the class teacher. The classroom environment promoted mutual respect, dialogue, ownership, a sharing of responsibility and reciprocity.

This was achieved through the development of an integrated inquiry-based, problem solving, classroom curriculum which created a synergy between literacy, the content areas and the Internet. The spiral nature of the curriculum, developed over two school years, helped to develop self-efficacy, motivation and engagement. It enabled the students to develop, deepen and hone their offline and online literacy skills over an extended period of time. The development of curriculum drew on a suite of well researched print-based instructional models, such as the CORI (Guthrie, 2004) model and the Reciprocal Teaching model (Palinscar & Brown, 1984). These models were adapted and transitioned onto an online format. This holds promise for the construction of curriculum and suggests that we do not need to reinvent the wheel or discard all that we hold dear to accommodate the new literacies into the classroom curriculum.

Developing a community of learners within the ecology of learning in classrooms reshapes the contexts for learning within those classrooms. The ability to work collaboratively to co-construct meaning, to problem solve as part of a team, and to develop new understandings by exploring multiple perspectives are valued in the workplace and should be nurtured in the classroom to enhance learning. Collaboration provides "multiple resources at the reading construction site" (Kucan & Beck, 1997, p. 289) and allows students to draw on their own knowledge and understanding, and on the strengths, insights and knowledge construction processes of others in the group (Putney, Green, Dixon, Durán & Yeager, 2000). Findings from the Dwyer (2010) study suggest that peer-to-peer collaboration

does not occur spontaneously and requires the introduction of structural frameworks, such as online reciprocal roles, share boards, and class discussions to develop the quality of interactions in groups. Further, "huddling" (Barron, 2003) occurs within the classroom environment when groups of students are presented with a choice of challenging inquiry-based tasks. This leads to an active, group-enhanced self-regulation and a deeper processing of texts. Students can examine, challenge, affirm, and extend one another's thinking and processing of texts. In the Castek (2008) study, challenging activities prompted the students to adopt shifting leadership roles within the groups where students shared emerging insights with other group members.

In the new literacies classroom teachers become "orchestrators of literacy learning environments" (Leu et al., 2004, p. 1599). Therefore, the teacher's role in designing classroom spaces and challenging curriculum to enhance learning becomes more not less important in a changing and evolving learning and literacy landscape. Traditional forms of professional development, such as summer courses or focus days have largely been unsuccessful in changing practice in classrooms. In the Dwyer (2010) study the researcher worked *in situ*, over an extended period, and in partnership with the class teachers in a professional learning community to provide sustained, customised on-site professional development. In turn, in a ripple effect, the class teachers involved in the study collaborated with and supported other class teachers in the school to accommodate the new literacies into classroom curriculum and pedagogies to support student learning in a school-wide learning ecology (Zhao & Frank, 2003). In a new literacies landscape where technology tools for literacy are continually emerging innovative ways, such as incorporating social networking tools, could be utilised to develop global elearning communities where teachers, teacher educators, researchers, experts in content areas and senior scholars in the fields of literacy and technology could collaborate to share understandings of how to develop effective

technological, pedagogical content knowledge to accommodate the new literacies framework (Mishra & Koehler, 2006).

The discourse in the digital divide debate has moved from a focus on *physical patterns of access* to technology to *equality of opportunity in access* to technology at home and in school according to socio-economic status (SES) (Hargittai & Hinnant 2008; Livingstone & Helsper, 2007; Warschauer, 2003). Studies show that students from lower SES and those struggling with print-based literacies have either limited access to technology (Karchmer, 2001) or are engaged in decontextualised, drill and practice type software programmes (Dalton & Strangman, 2006). This is in marked contrast to their more affluent peers who are engaged in collaborative, problem solving activities and the development of higher-order thinking skills in their access to technology (Becker, 2000). Therefore, technology compounds the divide between students of different SES, leading to a digitally determined (Dwyer & Harrison, 2008) Matthew effect (Stanovich, 1986). Those who need both quality of, and equality in, access to technology to enhance learning and literacy are "those receiving it the least" (Leu, 2006). Results from the Dwyer, (2010) study show the importance of access to online technologies for all students regardless of their print-based literacy achievements. Findings from the study illustrate the possibilities that the Internet and other ICTs have to actively engage, motivate and challenge these students on the margins to develop higher order thinking skills and problem solving strategies in challenging inquiry-based activities.

Conclusion

The chapter has explored some of the changes, challenges and consequences for literacy, classroom curricula and pedagogies in 21st century classroom communities. It has provided some emerging insights into the potential of the Internet and other ICTs to motivate all of our students to engage deeply with literacy and learning. Clearly, as teachers, teacher

educators, researchers, scholars and policy makers, we have just embarked on this journey and the road ahead looks promising. There is still much to learn about the new literacies of the Internet and other ICTs.

References

Afflerbach, P. (2007). *Understanding and using reading assessment, K-12*. Newark, DE: International Reading Association.

Afflerbach, P. A. & Cho, B. Y. (2009a). Identifying and describing constructively responsive comprehension strategies in new and traditional forms of reading. In S. Israel & G. Duffy (Eds.), *Handbook of reading comprehension research.* (pp. 69-90). Mahwah, NJ: Erlbaum.

Afflerbach, P. & Cho, B. Y. (2009b). Determining and describing reading strategies: Internet and traditional forms of reading. In H. S. Waters & W. Schneider (Eds.), *Metacognition, strategy use, and instruction* (pp. 201-225). New York: Guilford Press.

Afflerbach, P., Pearson, P. D., & Paris, S. G. (2008). Clarifying differences between reading skills and reading strategies. *The Reading Teacher, 61(5),* 364-373.

Agosto, D. E. (2002). Bounded rationality and satisficing in young people's Web-based decision-making. *Journal of the American Society for Information Science and Technology*, 53, 16–27.

Allington, R. L., & McGill-Franzen, A. (2009). Comprehension difficulties among struggling readers. In S. E. Israel & G. G. Duffy (Eds.), *Handbook of research on reading comprehension* (pp. 551-568). New York: Routledge.

Alvermann, D. (2008). Commentary: Why bother theorizing adolescents' online literacies for classroom practice and research? *Journal of Adolescent & Adult Literacy, 52,* 8-19.

Barron, B. (2003). When smart groups fail. *Journal of the Learning Sciences, 12(3),* 307-359.

Bates, M. J. (1989). *The design of browsing and berrypicking techniques for the online search interface.* Retrieved November 18, 2008 from http://www.gseis.ucla.edu/faculty/bates/berrypicking.html

Becker, H. J. (2000). Who's wired and who's not: Children's access to and use of computer technology. *The Future of Children, 10(2),* 44-75.

Bennett, S., Matton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology, 39(5),* 775-786.

Bilal, D. (2000). Children's use of the Yahooligans! web search engine:1. Cognitive, physical and affective behaviors on fact-based search tasks. *Journal* of *the American Society for Information Science, 51(7),* 646-665.

Bilal, D. (2001). Children's use of the Yahooligans! web search engine:11.Cognitive, physical and affective behaviors on research tasks. *Journal* of *the American Society for Information Science, 52(2), 118-136.*

Birkerts, S. (1994). *The Gutenberg elegies: The fate of reading in an electronic age*. Boston: Faber & Faber.

Bolter, J. D. (1998). Hypertext and the question of visual literacy. In D. Reinking, M. C. McKenna, L. D. Labbo, & R. D. Kieffer (Eds.), *Handbook of literacy and technology: Transformations in a post-typographic world* (pp. 3-14). Mahwah, NJ: Lawrence Erlbaum Associates.

Bulger, M. (2006). *Beyond search: A preliminary skill set for online literacy*. Retrieved May, 29, 2009 from http://transliteracies.english.ucsb.edu/research-papers/translit-bulger-onlinelit.pdf.

Burke, J. (2002). The Internet reader. *Educational Leadership, 60(3),* 38-42.

Castek, J. (2008). *How do 4th and 5th grade students acquire the new literacies of online reading comprehension? Exploring the contexts that facilitate learning*. Unpublished doctoral dissertation. University of Connecticut, Storrs.

Coiro, J. (2007). *Exploring changes to reading comprehension on the Internet: Paradoxes and possibilities for diverse adolescent readers*. Unpublished doctoral dissertation, University of Connecticut, Storrs.

Coiro, J. (in process). Purposeful, critical, and flexible: Key dimensions of online reading and learning. To appear in Spiro, R., DeSchrvyer, M., Schira-Hagerman, M., Morsink, P., & Thompson, P. (Eds.), *Reading at a crossroads? Disjunctures and continuities in current conceptions and practices*. New York: Routledge Press.

Coiro, J., & Dobler, E. (2007). Exploring the comprehension strategies used by sixth-grade skilled readers as they search for and locate information on the Internet. *Reading Research Quarterly, 42,* 214-257.

Coiro, J., Knobel, M., Lankshear, C., & Leu, D. J. (2008). Central issues in new literacies and new literacies research. In J. Coiro, M. Knobel, C. Lankshear, & D. J. Leu (Eds.), *Handbook of research on new literacies* (pp. 1-21). Mahwah, NJ: Lawrence Erlbaum Associates.

Crook, C., Harrison, C., Farrington-Flint, L., Tomás, C., Underwood, J. (2010). *Impact 09 final report*. BECTA: U. K.

Dalton, B., & Proctor, C. P. (2008). The changing landscape of text and comprehension in the age of the new literacies. In J. Coiro, M. Knobel, C. Lankshear, & D. J. Leu (Eds.), *Handbook of research on new literacies* (pp. 297-324). Mahwah, NJ: Lawrence Erlbaum Associates.

Dalton, B., Proctor, C. P., Uccelli, P., Mo. E., & Snow, C. E.(2011). Designing for diversity: The role of reading strategies and interactive vocabulary in a digital reading environment for fifth-grade monolingual English and bilingual students. *Journal of Literacy Research , 43(1)* 68-100.

Dalton, B., & Strangman, N. (2006). Improving struggling readers' comprehension through scaffolded hypertexts and other computer-based literacy programs. . In M. C. McKenna, L. D. Labbo, R. D. Kieffer, & D. Reinking (Eds.), *International handbook of literacy and technology. Volume II* (pp.75-93). Mahwah, NJ: Erlbaum.

DeSchryver, M., & Spiro, R. (2008). New forms of deep learning on the web: Meeting the challenge of cognitive load in conditions of unfettered exploration in online multimedia environments. In R. Zheng (Ed.), *Cognitive effects of multimedia environments.* Hershey, PA: IGI Global.

Dole, J. A., Nokes, J. D., & Drits, D. (2009). Cognitive strategy instruction. In S. E. Israel & G. G. Duffy (Eds.), *Handbook of research on reading comprehension* (pp. 347-372). New York: Routledge.

Dwyer, B. (2010). *Scaffolding Internet reading: A study of a disadvantaged school community in Ireland.* Unpublished doctoral dissertation, University of Nottingham: U.K.

Dwyer, B., & Harrison, C. (2008). There's no rabbits on the Internet: Scaffolding the development of effective search strategies for struggling readers during Internet inquiry. In Y. Kim & V. J. Risko (Eds.), *57th Yearbook of the National Reading Conference* (pp. 187-202). Oak Creek, WI: National Reading Conference.

Duke, N. K., Schmar-Dobler, E., & Zhang S. (2006). Comprehension and technology. In M. C. McKenna, L. D. Labbo, R. D. Kieffer, & D. Reinking (Eds.), *International handbook of literacy and technology. Volume II* (pp. 317-326). Mahwah, NJ: Erlbaum.

Eagleton, M. B., & Dobler, E. (2007). *Reading the web: Strategies for Internet inquiry*. New York: Guildford.

Eagleton, M. B., & Guinee, K. (2002). Strategies for supporting student Internet inquiry. *New England Reading Association Journal, 38(2),* 39-47.

Edwards, D. M., & Hardman, L. (1999). 'Lost in hyperspace': Cognitive mapping and navigation in a hypertext environment. In R. McAleese (Ed.), *Hypertext: Theory into practice* (2nd Rev. ed., pp. 90-105). Oxford, UK: Intellect Books.

Fabos, B. (2008). The price of information: Critical literacy, education, and today's Internet. In J. Coiro, M. Knobel, D. Leu, & C. Lankshear (Eds.), *Handbook of research on new literacies* (pp. 839-870). Mahwah, NJ: Erlbaum.

Fidel, R., Davies, R. K., Douglass, M. H., Holder, J. K., Hopkins, E. J., Miyagishima, B. K. , et al. (1999). A visit to the information mall: Searching behavior of high school students. *Journal of the American Society for Information Science, 50(1),* 24-37.

Flood, J., & Lapp, D. (1995). Broadening the lens: Towards an expanded conceptualization of literacy. In K. A. Hinchman, D. J. Leu, & C. K. Kinzer (Eds.), *Perspectives on literacy*

research and practice: The 44th Year Book of the National Reading Conference (pp. 1-16). Chicago: National Reading Conference.

Foltz, P. W. (1996). Comprehension, coherence and strategies in hypertext and linear text. In J.-F. Rouet, J. J. Levonen, A. Dillon, & R. Spiro (Eds.), *Hypertext and cognition.* (pp. 109-136). Hillsdale, NJ: Lawrence Erlbaum Associates.

Guinee, K., Eagleton, M. B., & Hall, T. E. (2003). Adolescents' Internet search strategies: Drawing upon familiar paradigms when sourcing electronic information sources. *Journal of Educational Computing Research, 29(3),* 363-374.

Gravemeijer, K., & Cobb, P. (2006). Design Research from a learning perspective. In J.van den Akker, K. Gravemeijer, S. S., McKenney, & N. Nieveen (Eds.), *Educational design research* (pp. 17-51). New York: Routledge.

Guthrie, J. T. (2004). Classroom contexts for engaged reading: An overview. In J. T. Guthrie, A. Wigfield, & K. C. Perencevich (Eds.), *Motivating reading comprehension. Concept-oriented reading instruction* (pp. 87-112). Mahwah, NJ: Lawrence Erlbaum Associates.

Hargittai, E., & Hinnant, A. (2008). Digital inequality: Differences in young adults' use of the Internet. *Communication Research, 35(5),* 602-621.

Harrison, C. (2008). Researching technology and literacy. Thirteen ways of looking at a blackboard. In J. Coiro, M. Knobel, C. Lankshear, & D. J. Leu (Eds.), *Handbook of research on new literacies* (pp. 1283-1293). Mahwah, NJ: Lawrence Erlbaum Associates.

Hartman, D. K. (1995). Eight readers reading: The intertextual links of proficient readers reading multiple passages. *Reading Research Quarterly, 30(3),* 520-561.

Hartman, D. K., Morsink, P. M., & Zheng, J. (2010). From print to pixels: The evolution of cognitive conceptions of reading comprehension. In E. A. Baker (Ed.), *The new literacies: Multiple perspectives on research and practice* (pp. 131-164). New York, NY: Guilford Press.

Henry, L. A. (2006). SEARCHing for an answer: The critical role of new literacies while reading on the Internet. *The Reading Teacher, 59(7),* 614-627.

Hill, J. R., & Hannafin, M. J. (1997). Cognitive strategies and learning on the World Wide Web. *Educational Technology Research and Development, 45(4),* 37-64.

Hirsh, S. G. (1999). Children's relevance criteria and information seeking on electronic resources. *Journal of the American Society for Information Science, 50(14),* 1265-1283.

Hutchison, A. & Reinking, D. (2011). Teachers' perceptions of integrating Information and Communication Technologies into literacy instruction: A national Survey in the U.S. *Reading Research Quarterly, 46(4),* 308-329.

International Reading Association. (2009). *New literacies and 21st century technologies: A position statement.* Newark, DE: IRA. Retrieved February, 1, 2010 from www.reading.org/General/AboutIRA/PositionStatements/21stCenturyLiteracies.aspx

Kafai, Y., & Bates, M. J. (1997). Internet web-searching instruction in the elementary classroom : Building a foundation for information literacy. *School Library Media Quarterly, 25(2),* 103-111.

Karchmer, K. A. (2001). The journey ahead: Thirteen teachers report how the Internet influences literacy and literacy instruction in their K-12 classrooms. *Reading Research Quarterly, 36,* 442-467.

Kress, G. (2003). *Literacy in the new media age.* London: Routledge.

Kress, G. (2010). *Multimodality: A social semiotic approach to contemporary communication.* London: Routledge.

Kucan, L., & Beck, I. L. (1997). Thinking aloud and reading comprehension research: Inquiry, instruction and social interaction. *Review of Educational Research, 67(3),* 271-279.

Kuiper, E., & Volman, M. (2008).The web as a source of information for K-12 education. In J. Coiro, M. Knobel, C. Lankshear, & D. J. Leu, (Eds.), *Handbook of Research on New Literacies* (pp. 267-296) Mahwah, NJ: Erlbaum.

Labbo, L. D., & Reinking, D. (1999). Negotiating the multiple realities of technology in literacy research and instruction. *Reading Research Quarterly, 34(4),* 478-492.

Lawless, K. A., & Kulikowich, J. M. (1998). Domain knowledge, interest, and hypertext navigation: A study of individual differences. *Journal of Educational Multimedia and Hypermedia, 7(1),* 51-69.

Leu, D. J. (2006). New literacies, reading research, and the challenges of change: A deictic perspective. In J. V. Hoffman, D. L. Schallert, C. M. Fairbanks, J. Worthy, & B. Maloch (Eds.), *The 55th Yearbook of the National Reading Conference*. (pp. 1-20). Milwaukee, WI: National Reading Conference

Leu, D. J., Coiro, J., Castek, J., Hartman, D. K. Henry, L. A., & Reinking, D. (2008). Research on instruction and assessment in the new literacies of online reading comprehension. In C. C. Block & S. R. Parris (Eds.), *Comprehension instruction: Research-based best practices* (2nd ed., pp. 321-346). New York: The Guildford Press.

Leu, D. J., & Kinzer, C. K. (2000).The convergence of literacy instruction with networked technologies for information and communication. *Reading Research Quarterly, 35(1),* 108-127.

Leu, D. J., Kinzer, C. K., Coiro, J., & Cammack, D. (2004). Towards a theory of new literacies emerging from the Internet and other Information and Communication Technologies. In R. B. Ruddell & N. Unrau (Eds.), *Theoretical models and processes of reading* (5th ed., pp. 1570-1613). DE: International Reading Association.

Leu, D. J., O'Byrne, W. I., Zawilinski, L., McVerry, J. G., & Everett-Cocapardo, H. (2009). Expanding the new literacies conversation. *Educational Researcher, 38, 264-269.*

Leu, D. J., Zawlinski, L., Castek, J., Banerjee, M., Housand, B. C., Liu, Y. (2007). What is new about the new literacies of online reading comprehension? In L. S. Rush, A. J. Eakle, & A. Berger (Eds.), Secondary school literacy: What research reveals for classroom practice (pp. 37-68). Urbana, IL: National Council of Teachers of English.

Lipson, M. Y., & Wixson, K. K. (1986). Reading disability research: An interactionist perspective. *Review of Educational Research, 56(1),* 111-136.

Livingstone, S., & Helsper, E. (2007). Gradations in digital inclusion: Children, young people and the digital divide. *New Media and Society, 9(4),* 671-696.

Malloy, J., Castek, J., Leu, D. J. (2010). Silent reading and online reading comprehension. In E. Hiebert and R. Reutzel, (Eds). *Revisiting silent reading*. (221-240). Newark, DE: International Reading Association.

McCombs, B. (1996). Alternative perspectives for motivation. In L. Baker, P. Afflerbach, & D. Reinking (Eds.), *Developing engaged readers in school and home communities* (pp. 67-89). Mahwah, NJ: Erlbaum.

McEneaney, J. E. (2006). Agent-based literacy theory. *Reading Research Quarterly,41(3),* 352-371.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage.

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A new framework for teacher knowledge. *Teachers College Record, 108(6),* 1017-1054.

Moos, D. C., & Azevedo, R. (2008). Self-regulated learning with hypermedia: The role of prior domain knowledge. *Contemporary Educational Psychology, 33,* 270-298.

Morpurgo, M. (1996). *The butterfly lion.* London: Harper Collins Children's books.

Nachmias, R., & Gilad, A. (2002). Needle in a hyperstack: Searching for information on the world wide web. *Journal of Research on Technology, 34(4),* 475-486.

Nahl, D., & Harada, V. H. (1996). Composing Boolean logic statements: Self-confidence, concept analysis, search logic, and errors. *School Library Media Quarterly, 24(4),* 199-207.

Owens, R. F., Hester, J. L., & Teale, W. H. (2002).Where do you want to go today? Inquiry-based learning and technology integration. *The Reading Teacher, 55(7),* 616-625.

Palinscar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1(2),* 117-175.

Paris, S. G., Lipson, M. Y., & Wixson, K. K. (1983). Becoming a strategic reader. *Contemporary Educational Psychology, 8,* 293-316.

Pearson, P. D. (2009). The roots of reading comprehension instruction. In S. E. Israel & G. G. Duffy (Eds.), *Handbook of research on reading comprehension* (pp. 3-31). New York: Routledge.

Pearson, P. D., & Gallagher, M. C. (1983). The instruction of reading comprehension. *Contemporary Educational Psychology,* 8, 317-344.

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon,* 9, 5, 1-6. Retrieved August, 14, 2009 from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf.

Pressley, M., & Afflerbach, P. (1995). *Verbal protocols for reading: The nature of constructively responsive reading.* Hillsdale, NJ: Erlbaum.

Pressley, M., & Harris, K. H. (2006). Cognitive strategy instruction: From basic research to classroom instruction. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of educational psychology* (2nd ed., pp. 265-286). Mahwah, NJ: Erlbaum.

Purves, A. (1998). Flies in the web of hypertext. In D. Reinking, M. C. McKenna, L. D. Labbo, & R. D. Kieffer (Eds.), *Handbook of literacy and technology : Transformations in a post-typographic world* (pp. 235-252). Mahwah, NJ: Lawrence Erlbaum Associates.

Putney, L. A. G., Green, J., Dixon, C., Durán, C., & Yeager, B. (2000). Consequential progressions: Exploring collective-individual development in a bilingual classroom. In C. D. Lee & P Smagorinsky (Eds.), *Vygotskian perspectives on literacy research:*

Constructing meaning through collaborative inquiry (pp. 86-126). New York: Cambridge University Press.

RAND Reading Study Group. (2002). *Reading for understanding: Toward a research and development program in reading comprehension*. Pittsburgh, PA: Office of Educational Research and Improvement.

Reinking, D. (1998). Synthesising technological transformations of literacy in a post-typographic world. In D. Reinking, M. McKenna, L. Labbo, & R. Kieffer (Eds.), *Handbook of literacy and technology: Transformations in a post-typographic world* (pp. xi-xxx). Mahwah, NJ: Erlbaum.

Reinking, D., & Bradley, B. A. (2008). *On formative and design experiments.* New York: Teachers College Press.

Reinking, D., Labbo, L. D., & McKenna, M. C. (2000). From assimilation to accommodation: A developmental framework for integrating digital technologies into literacy research and instruction. *Journal of Research in Reading, 23(2),* 110-122.

Rosenblatt, L. M. (1978). *The reader, the text, the poem: The transactional theory of literary work.* Carbondale: Southern Illinois University Press.

Schacter, J., Chung, G. K., & Dorr, A. (1998). Children's Internet searching on complex problems: Performance and Process Analyses. *Journal of the American Society for Information Science, 49(9),* 840-849.

Shenton, A. K., & Dixon, P. (2003). A comparison of youngsters' use of CD-Rom and the Internet as information resources. *Journal of the American Society for Information Science and Technology, 54(11),* 1029-1049.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57(1),*1-22.

Spiro, R. J., Coulson, R. L., Feltovich, P. J., & Anderson, D. K. (2004).Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains. In R. B. Ruddell & N. J. Unrau (Eds.), *Theoretical models and processes of reading* (5th ed., pp. 640-654). Newark, DE: International Reading Association.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21(4),* 360-407.

Sutherland-Smith, W. (2002). Weaving the literacy web: Changes in reading from page to screen. *The Reading Teacher, 55(7),* 662-669.

Tierney, R. J. (2000). Literacy assessment reform: Shifting beliefs, principled possibilities, and emerging practices In N. D. Padak et al. (Eds.), *Distinguished educators on reading: Contributions that have shaped effective literacy instruction* (pp. 517-541). Newark, DE: International Reading Association.

Treymayne, M., & Dunwoody, S. (2001). Interactivity, information processing and learning on the World Wide Web. *Science Communication, 23(2),* 111-134.

Tsai, M.-J., Tsai, C.-C. (2003). Information searching strategies in web-based science learning: The role of Internet self-efficacy. *Innovations in Education and Teaching International, 40(1),* 43-50.

University College London CIBER group (2008). *Information behaviour of the researcher of the future*. London: University College London. Retrieved September, 2, 2008 from http://www.bl.uk/news/pdf/googlegen.pdf

Wallace, R., & Kupperman, J. (1997). *On-line search in the science classroom: Benefits and possibilities*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago. Retrieved October 18, 2008 from https://www.msu.edu/~mccrory/pubs/online_search.pdf.

Warschauer, M. (2003). *Technology and social inclusion: Rethinking the digital divide.* Cambridge, MA: The MIT Press.

Young, P. A. (2008). Exploring culture in the design of new technologies of literacy. In J. Coiro, M. Knobel, C. Lankshear, & D. J. Leu (Eds.), *Handbook of research on new literacies* (pp. 325-358). Mahwah, NJ: Lawrence Erlbaum Associates.

Zhang, S & Duke, N. K. (2008). Strategies for Internet reading with different reading purposes: A descriptive study of twelve good Internet readers, *Journal of Literacy Research, 40(1)* 128-162.

Zhao, Y., & Frank, K. A. (2003). Factors affecting technology uses in schools: An ecological perspective. *American Educational Research Journal, 40(4),* 807-840.